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1 Scope:

This specification establishes the procedure for LHC D1 dipole cryostat insertion.

2 Applicable Documents:

The following documents, in effect on the date of issue of this specification, form a part of this specification:

RHIC-MAG-M-7422	CQS Multi-Layer Insulation Fabrication
RHIC-MAG-R-7423	Multilayer Insulation Installation
RHIC-MAG-Q-1000	Control of Measurement Test Equipment
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
14010018	D1 Pressure Leak Check Assembly
14060006	D1 Magnet Assembly Cryostatted

3 Requirements:

3.1 Material/Equipment

Cold Mass Assembly Fixture	BNL Dwg. 25-1747.01-5
Lifting Beam	BNL Dwg. 25-1782.02-5
Insertion Fixture	BNL Dwg. 25-1773.01-5

3.2 Safety Precautions

3.2.1 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.

3.2.2 Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the required welding equipment.

3.2.3 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be trained in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.

- 3.2.4 Operators shall be trained by their Cognizant Technical Supervisor in the operation of the Insertion Fixture.
- 3.2.5 Specific steps of this procedure contain electrical and mechanical assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.
- 3.3 Procedure
 - 3.3.1 Vacuum Vessel Preparation
 - 3.3.1.1 Brush and vacuum the interior of the vacuum vessel, if required. Make sure that the threads in the leg surfaces are clean.
 - 3.3.1.2 Check the vacuum vessel leg sealing surfaces for any damage (radial scratches, nicks, etc.).
 - 3.3.1.3 Install the six BNL survey sockets (12065018) onto the cryostat leg castings using Loctite on the threads. Torque them to 8-10 foot pounds.
 - 3.3.1.4 Install three full dog-point set screws on each of the six Taylor-Hobson fiducial cups (14060209) so that the point extends 2mm (.079 in.) beyond the bottom. Fill the fiducial mounting base with stycast 2850 epoxy to a depth of about 3mm. Then install the cups. Torque the locking screws to 8-10 ft-lbs.
 - 3.3.1.5 Align the vacuum vessel on the insertion fixture using the pins and spherical bearings. Secure with six C-clamps.
 - 3.3.1.6 Install lower steel post-alignment fixtures (loosely).
 - 3.3.1.7 Slide in the steel slide plate.
 - 3.3.1.8 Secure slide plate to post-alignment fixture (lower) with filler piece.
 - 3.3.1.9 Secure post-alignment fixture to vacuum vessel (lower).
 - 3.3.1.10 Install slide plate extension.
 - 3.3.1.11 Position tow-plate with post alignment fixtures on insertion fixture (upper).

- 3.3.1.12 Position heat shield blankets over tow plate (upper post alignment fixture will extend through post holes in blankets). Outer blanket goes on first, then inner blanket.

NOTE

Be sure that no insulation is between tow plate and post alignment fixtures.

- 3.3.2 Cold Mass Build Up
- 3.3.2.1 Place cold mass on support fixture using the lifting beam (25-1782.02-5). The cold mass must be adequately and safely suspended so that the three post locations are accessible from underneath.
- 3.3.2.2 Install the lower post halves in accordance with the assembly drawing. Remove lower steel ring from lower posts.
- 3.3.2.3 Mark lower post halves as follows: LE, CTR, NLE. Apply unique witness marks across post halves to allow same rotational positioning when bottom halves are reinstalled later.
- 3.3.2.4 Move the cold mass to set-up table.
- 3.3.2.5 Measure the height from the bottom of the cradles to the top of lower post flange in four places, 90 degrees apart, to the nearest .001 in. Record readings in traveler and calculate average for each post.
- 3.3.2.6 Mark heat shield mounting plates, LE, CTR, NLE. Measure thickness in four places, near I.D. 90 degrees apart, to the nearest .001 in. Record readings in traveler and calculate average for each plate.

- 3.3.2.7 Post shims shall be selected so that the center post assembly is .89mm (.035 in.) higher than the two outer post assemblies. Make up shim packs and identify as LE, CTR, NLE. Check vacuum vessel cradle surfaces for out-of-parallel (incoming inspection data) and make angled shim to correct as necessary. Record the shim thickness data in the traveler

NOTE

**Nominal shim size for outer posts is .096 in. Nominal shim size for center post is .061 in. However, actual shim thickness shall be adjusted so that:
The height between the bottom of the outer cradles and the bottom of the outer cryostat leg casting is 11.120". The height between the bottom of the center cradle and the bottom of the center cryostat leg casting is 11.155"**

- 3.3.2.8 Lift the cold mass and remove lower posts. Place cold mass on set-up table.
- 3.3.2.9 Make sure that cold mass insulating blanket is properly wrapped around the cold mass and ultrasonically welded per specifications.
- 3.3.2.10 Position the lower heat shield with lower heat shield mounting plates on set up table. Match mounting plates as marked with correct positions on table.
- 3.3.2.11 Position both pipe blankets over lower heat shield. Align post holes outer blanket first, inner second.
- 3.3.2.12 Lift cold mass and position cold mass over lower heat shield 1/8" from lower heat shield (Posts extend through holes in blankets).
- 3.3.2.13 Attach lower heat shield to upper posts (loosely) with (2) .250-20 screws per post. Assure that no insulation is between posts and lower heat shield.
- 3.3.2.14 Lower the cold mass to contact lower heat shield and secure to upper posts by tightening the (2) .250-20 screws per post.
- 3.3.2.15 Attach passive heater strap to heat shield as indicated. Torque all screws to 18 in-lb.
- 3.3.2.16 Tie shield blankets up and out of the way.
- 3.3.2.17 Lift cold mass with lower heat shield and heat shield blankets and place on slide plate on insertion fixture.

- 3.3.2.18 Ultrasonic weld inner and outer pipe blankets by interleaving every five or six layers of insulation. Be sure to use a stainless steel strip as back-up when making ultrasonic welds. During the welding of the last layer, spacer material 12060093-17 must be put on top of the outer layer of aluminized mylar to reinforce welds. With Kevlar cord, tie blankets up to pull insulation away from lower heat shield.
- 3.3.2.19 Install the upper heat shield on top of the lower, making sure that the upper heat shield is even on both ends with the lower heat shield.
- 3.3.2.20 Fusion weld both sides of the heat shield and allow to cool. Make sure that the weld blanket tool is used with vise grip pliers as needed. Make sure weld screen is in place during welding operation to avoid injury.
- 3.3.2.21 Interleave and ultrasonic weld approximately every ten layers of the inner heat shield blanket. Use a stainless steel backing strip when welding.
- 3.3.2.22 Interleave and ultrasonic weld approximately every ten layers of the outer heat shield blanket. Spacer material (12060093-17) must be used on top of the last layer to reinforce welds. Use stainless backing strip when welding.
- 3.3.2.23 Wrap the temporary .010 in. thick mylar shield around the outside of the insulation blankets and tape into position at the end volumes.
- 3.3.3 Cold Mass Installation
 - 3.3.3.1 Winch the cold mass assembly into the vacuum vessel. Align the center upper post on the cold mass with the corresponding vacuum vessel post hole center using the post alignment fixture.

NOTE

Watch for interference during pull-in.

- 3.3.3.2 Remove mylar.
- 3.3.3.3 Install the correct shims and lower post over center lifting mechanism. Lift cold mass with two A-frame gantries and center hydraulic lift mechanism.
- 3.3.3.4 Remove aluminum extension filler piece and tow-plate.
- 3.3.3.5 Remove slide plate and post upper alignment fixtures.

- 3.3.3.6 Loosely install lower posts with correct shims to remaining upper posts with bolts and lock washers. Use anti-seize compound (12010109) on bolts.
- 3.3.3.7 Attach lower posts, with correct hardware, (capturing the laminated shim 12011399) to vacuum vessel, torque bolts to 35 foot pounds.
- 3.3.3.8 Lower cold mass and remove lifting tooling.
- 3.3.3.9 Tighten post bolts to 35 foot-pounds.
- 3.3.4 Vacuum Vessel Sag Measurement
 - 3.3.4.1 Move cryostatted magnet back to inspection table. Support cryostat at the two outer leg castings. Center leg is unsupported.
 - 3.3.4.2 For each leg, measure height from table to bottom of each leg casting at four locations 90⁰ apart in the area just outside the post flange. Enter data into the traveler and calculate average.
 - 3.3.4.3 Install port covers (12065091) and greased “O” rings (NAS1593-453) with Apiezon “M” grease and torque bolts to 35 foot pounds.
 - 3.3.4.4 Remove hold-down clamps and transport magnet to horizontal test facility Bay “E”.

4 Quality Assurance Provisions:

- 4.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.
- 4.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.
- 4.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

5 Preparation for Delivery:

N/A